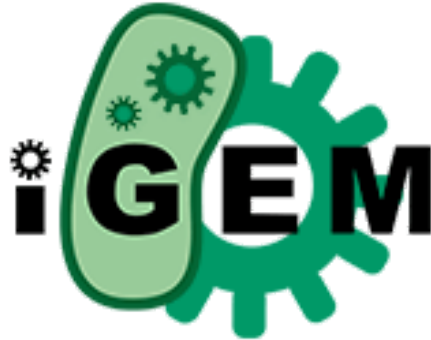


# **iGEM Edu Day Manual**

## **DD/MM/YYYY**



**Target audience: Year 12/13**

### **Equipment required**

- 1. Tables**
- 2. Chairs**
- 3. Laptops**
- 4. Flipcharts and Flipchart stands**
- 5. Markers,**
- 6. Poster boards**
- 7. Projector**
- 8. Name tags and others depending on specific needs**

# Overview

iGEM Edu Day is outreach event that promotes iGEM and synthetic biology and is an education event about synthetic biology and iGEM science. It comprises of talks, science fair and a mini iGEM competition.

Talks are to educate students about iGEM and synthetic biology and designed to serve as background knowledge for mini iGEM competition, which is the main event of the day.

Science fair is then set out to showcase students what synthetic biology are able to achieve in practice.

Finally, mini iGEM competition will be held. Participating students will get to apply what they have learnt from the talks and science fair to this competition. **They will have a chance to have a taste of iGEM in the form of the brainstorming process that every team goes through at the start of the project.** Students will be in groups to create a mini iGEM project and, at the end of the competition, present their project.

The important part of the mini iGEM competition is to allow students to **try out what it is like to use synthetic biology principle to address issues.** As such, the details of each team's science, although important, should not be overemphasized. It is the team's' ability to research on a problem that is worth being dealt with and come up with novel approach that should be judged on.

In this manual, the slides used in 2016 Sheffield iGEM Edu Day are put down as examples. Instructions and suggestions on how to run the event are also provided.

# Timetable

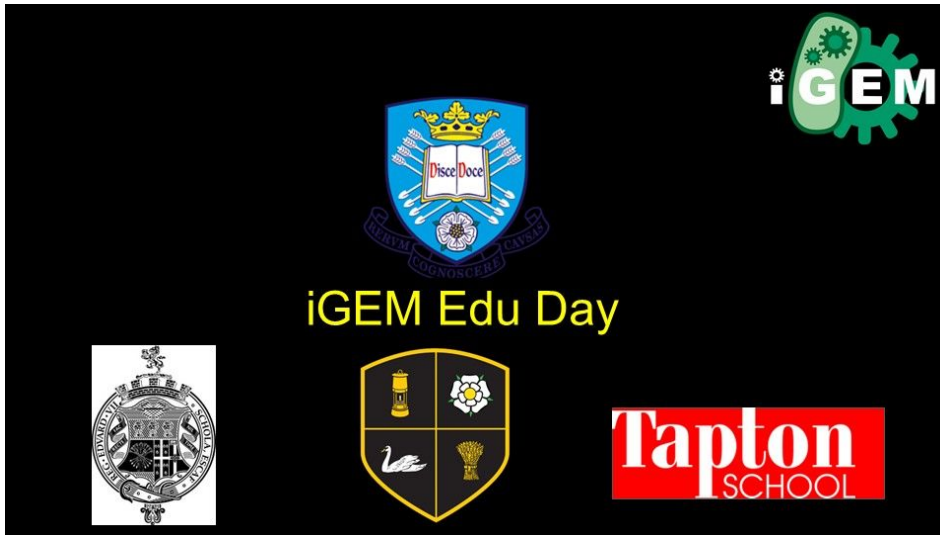
Time	Activity	Content
09:00-10:00	Set Up	
10:00-10:30	Arrival and Welcome	<ol style="list-style-type: none"> <li>1. Welcoming words (5mins)</li> <li>2. A talk introducing iGEM Day (15 mins)</li> </ol>
10:30-11:30	Talks	<ol style="list-style-type: none"> <li>1. The power of synthetic biology Dr/ Prfo. _____ (15mins)</li> <li>2. "iGEM and Our City" by_(name) _(15mins)</li> <li>3. iGEM __ (team name) __ 20__ (15mins) by __ (name) __</li> </ol>
11:30-11:45	Introducing the competition	<ul style="list-style-type: none"> <li>• A talk setting the stage for mini iGEM by _____</li> </ul>
Move to the activity area		
12:00-13:00	Lunch, activities and get to know your teammates	<ul style="list-style-type: none"> <li>• Eating</li> <li>• Interactive activities</li> </ul> <p>Examples: iGEM Edu Day 2016 in Sheffield</p> <ol style="list-style-type: none"> <li>1. Timeline of Antibiotics</li> <li>2. Pseudo pills showing annual wasteful antibiotics in Sheffield</li> <li>3. Microscope slides of blood and E.coli</li> <li>4. Microscope</li> </ol>
13:00-14:00	Mini iGEM Competition: Forming and designing a project	<ul style="list-style-type: none"> <li>• Brainstorming</li> </ul>
14:00-14:45	Mini iGEM Competition: Presenting and Judging	<ul style="list-style-type: none"> <li>• Each team 5 minutes</li> </ul>
14:45-15:00	Feedback	

[illegible]

# Arrival and Welcome

In this section, students are introduced to iGEM, Synthetic biology and the iGEM Edu Day

## 1. Welcome



## 2. Introducing iGEM

### What is iGEM?

iGEM = International Genetically Engineered Machine

- From a study course to an international competition
- Making a team: Secondary school, Undergraduate, Overgraduate teams
- Competition concludes in Boston



Boston, Massachusetts, USA

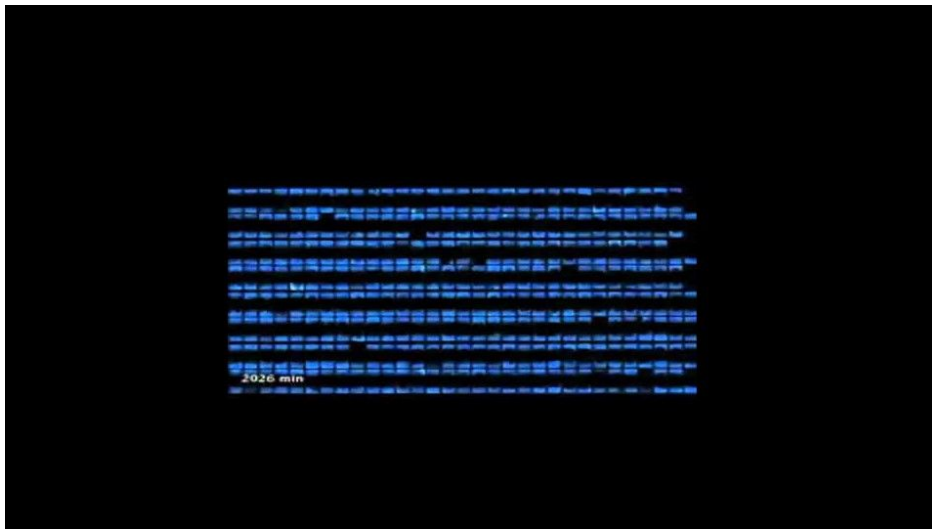
### 3. Introducing Synthetic Biology

- Marriage of biology and engineering (Buchan, 2016)

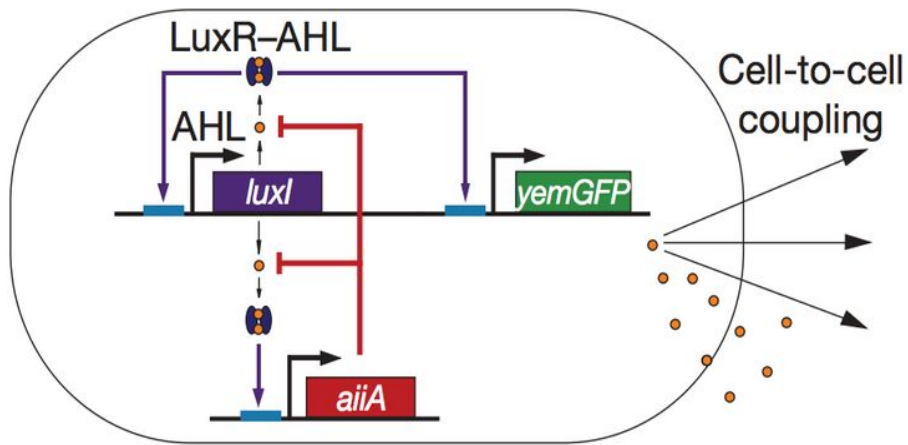
#### What is Synthetic Biology?

"redesigns existing biological parts and constructs new biological machinery with engineering principles. In most cases, it is done for the purpose of offering applicability."

#### 3.1. An example of synthetic Biology



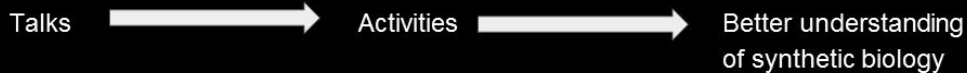
- [https://www.youtube.com/watch?v=AskfxX8SgrM&feature=player\\_embedded](https://www.youtube.com/watch?v=AskfxX8SgrM&feature=player_embedded)
- This example is based on MIT's assignment for the original iGEM study course before it became a competition. The data, however, is from a PHD student's, Tal Danino, website in 2010: <http://www.taldanino.com/blinking-bacteria/>.



- His E.coli have the above depicted construct. They are exposed to arsenic, which activates the construct causing them to fluoresce in a regular rhythm. Initially they fluoresce independently of each other however after a period of time the E. coli go through a process called quorum sensing which causes the E. coli to fluoresce with respect to each other. This leads impressive 'mexican waves' of fluorescence.
- This video should hopefully show attending students an interesting side of synthetic biology.

#### 4. Introducing iGEM Edu Day

##### What is iGEM Edu day?



- Here the host tells the audience that iGEM Edu day is to allow attending students to have a better understanding of synthetic biology through a series of talks and activities. The talks are designed to educate the students on synthetic biology so they will be prepared for the activities, more importantly the mini iGEM competition.

## 5. Walking the students through the schedule

### Schedule of Today

Time	Activity
10:00-10:30	Arrival and Welcome
10:30-11:30	Talks
11:30-11:45	Introduce the competition
iGEM mini competition	
12:00-13:00	Lunch, activities and get to know your teammates
13:00-14:00	Competition: Forming and designing a project
14:00-14:45	Competition: Presenting and Judging
14:45-15:00	Feedback

## 6. Briefly introducing mini iGEM competition

### A mini iGEM competition

- Groups of 6-8
- Simulation of iGEM



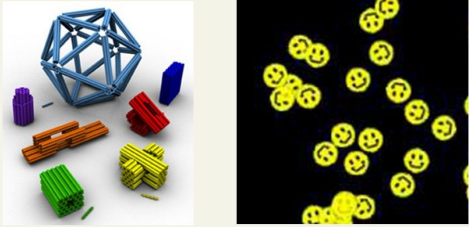

- The speaker at this point should highlight the main event of the day- mini iGEM competition. So that students will be aware that they will be split in groups later on and engage in activities.



# Talks


## 1. Power of synthetic biology

- A talk introducing synthetic biology to students, preferably given by academia. E.g., For 2016 Sheffield iGEM Edu Day, it is given by Dr. Egbert Hoiczky.

<p><i>Department of Molecular Biology &amp; Biotechnology</i></p> <p><b>Modern Marvels of Genetic Engineering</b></p> <p><b>Egbert Hoiczky</b> October, 14<sup>th</sup> 2016</p>	<p><b>DNA, the Code of Life</b></p> 
<p><b>DNA is a highly stable Molecule that can be shaped in various Forms</b></p> 	<p><b>Genetic Engineering of Yeast Cells offers a solution</b></p> 

## 2. iGEM and Our City


- For cities that have previous participation experiences with iGEM, they can give a talk on these previous teams.
- For example, 2016 iGEM Sheffield's advisor Kyle Buchan talked on his previous iGEM experience and the history of iGEM in Sheffield.







The University Of Sheffield.

### iGEM and Sheffield

A worldwide synthetic biology competition.  
A steel city.




Kyle Buchan


### iGEM Sheffield

2008




**On a mission for fluorescence**  
Detecting bacterially-contaminated water in developing countries

2009




**Switched On!**  
Light-sensing bacteria

2010




**iColi**  
Cholera-sensing bacteria





2014



**Fatbergians**  
Engineered bacteria able to break down massive "icebergs" of fat.



### Antibiotics in Sheffield

1927: Fleming discovers antibiotics

1929: In Sheffield, Doctor Cecil George Paine uses Penicillin for the first time to cure an eye infection

1930: In Sheffield, Chair of Pathology Howard Florey thinks it's pretty neat

1939 -> Florey takes Penicillin to America, produced on a massive scale for the war effort

- This will serve as a good transition for the next talk, which will be introducing the host's own iGEM project

## 3. Host's project

- Ideally, it should be simplified down according to attendants; biological background so that the presentation would be understandable.

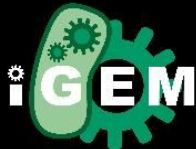
# Introducing the competition

- This is the part where attending students will be informed about the structure and the aim of the mini iGEM competition.



## Mini iGEM Competition - iGEM Edu Day edition

- The goal of each team.



### Mini iGEM competition

- Goal of each team:



Set up a mini iGEM project

→	Ways to address problems
→	Technologies that better our lives
→	Pure scientific advance


- More on the structure of the competition. Each team will have an iGEMer on their team as an advisor. Here shows a slide introducing our iGEMers.

## Mini iGEM competition


- Groups of 6-8
- 1 iGEMer




Brandon




Oana




Jamie



Wai Ching




James



Wesley

- The role of iGEMers should be an advisor. On the team, they will provide guidance and keep the discussion in the right direction. Essentially, what an advisor typically does on an iGEM team.

## The role of your iGEMer



- An “Advisor”
- Guidance on what is feasible
- Knowledge on what has been done in the past

- Walk through the competition schedule

## Schedule



- 12:00-1:00 Lunch and speaking with teammates
- 13:00-14:00 Forming and Designing a project
- 14:00-14:45 Presenting and Judging

- Break down the objectives of each team.

## Forming and Designing a project



### Objectives:

1. Research and choose a problem
2. Justify the choice of the problem
3. Propose and design a project
4. Envision how it would impact the world
5. Come up with a presentation

- First objective: research and choose a problem. In this mini iGEM project, The science of each team is important but not the main judging criteria. Hence, the host should encourage research and find issues need addressing. Like in the actual iGEM competition, there are tracks for teams, which are here provided to offer students directions as to where their project could go.

## Objective 1. Research and choose a project

- Category
  - Health & Medicine
  - Energy
  - Environment
  - Food & Nutrition

- Students will be provided with laptops so that they can research for the brainstorming process.

## Objective 1. Research and choose a problem

Your resources:

1. Laptop
2. iGEMer
3. Ambassadors
4. The judges' tips



- Second objective: Justify your choice. This is where teams need to convince why their problem/project is important. They should demonstrate their research on the problem of choice.

## Objective 2. Justify your choice



- Third Objective: Propose and design a project. Here two past iGEM projects are given as examples. 2015 iGEM Consort from high school division and 2015 iGEM Braunschweig from undergrad division.

## Objective 3. Propose and design a project



2015 iGEM Consort, Alberta (High School)



- Agriculture and the oil industry coexist
- Oil wells are drilled on land adjacent to crops and cattle
- No test that can check for oil contamination on the actual site
- Environmental contaminant Sensor, ECOS, is a biological sensor designed to detect aromatic hydrocarbons found in soil, particularly xylene

## Objective 3. Propose and design a project



2014 iGEM Braunschweig E. coli

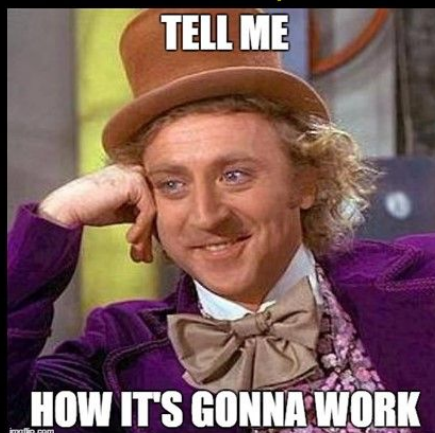


- The natural microbiota inside the cow's rumen releases dangerous amounts of greenhouse gases as they help digest the animal's food.
- Reduce the methane levels through a genetically engineered bacterium named E. coli, using the soluble form of the enzyme complex methane monooxygenase (sMMO) for hydroxylation of methane to methanol.



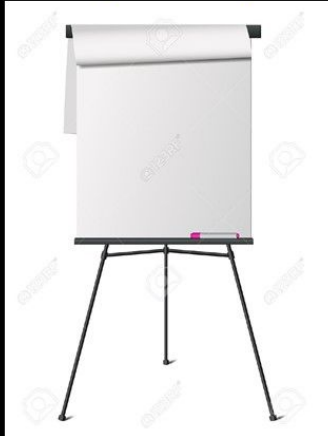
- Fourth objective: Envision the impact. Students here should essentially do what iGEM teams do in human practices. They should identify the potential people that will be impacted by their project and discuss how.

## Objective 4. Envision the impact



- Fifth Objective: teams need to come up with a 5 minute presentation followed by a Q&A session. They will be provided by a flipchart for the brainstorming session and designing a poster for the presentation.

## Objective 5. Come up with a presentation



- Finally, split students into groups. Groups of six is recommended.





# Lunch time and getting to know your teammates

- At this point, students should have been divided and got into groups. For 2016 iGEM Edu Day hosted by Sheffield, catering is provided. Lunch time is thus an opportunity for students to get to know their teammates. During lunch times, students will have the opportunity to explore interactive activities provided in the form of a science fair. The followings are the ones iGEM Sheffield 2016 provided.





- Pseudo pills showing the 700,000 unnecessary antibiotics prescribed annually in Sheffield.



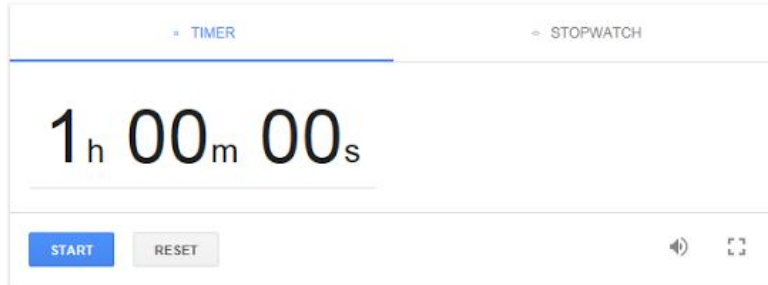
- Microscope and slides of blood and E.coli.



- iGEM posters from current or past teams showcasing work of iGEM.
- Over lunch and activities, groups can also get a head start and engage in an “unofficial” brainstorming time to think about their project.

# Mini iGEM Competition: Forming and designing a project

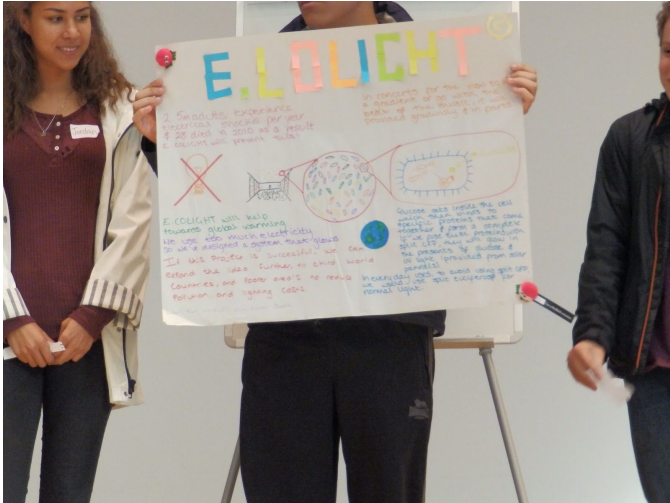
- Students will be given about an hour to form their project and achieve the said five objectives.





# Mini iGEM Competition: Presenting and Judging

- Each team has the opportunity to go up on stage and do a 5 minutes presentation followed by a Q&A session.



## Prize: best project, best presentation and best poster

- Best project: Hypoband



# Appendix

## Guide for iGEMers to advise a team - Ice breaking

In case there is a lack of ideas or discussions. iGEMers could briefly tell them about what previous iGEM teams have done. Click on the links to their wiki.

### [2014 iGEM Wageningen](#) **Banana Guard**

- Banana plants are threatened by *Fusarium oxysporum*.
- Created BananaGuard, a genetic system in *Pseudomonas putida* that detects the presence of *F. oxysporum* in the soil and produces a combination of antifungals to remove the fungal threat.

### [2014 iGEM Braunschweig](#) **E. cowli - Fighting climate change at the source**

- The natural microbiota inside the cow's rumen releases dangerous amounts of greenhouse gases as they help digest the animal's food.
- Reduce the methane levels through a genetically engineered bacterium named E. cowli, using the soluble form of the enzyme complex methane monooxygenase (sMMO) for hydroxylation of methane to methanol.

### [2014 iGEM Dundee](#)

- Cystic Fibrosis
- designing and testing a device that will rapidly and non-invasively identify the bacteria colonising a Cystic Fibrosis patient.

### [2014 iGEM NCTU](#) **Formosa**

- Pesticides could be environmentally hazardous chemicals
- Express DNA sequence of PBAN (Pheromone biosynthesis activating neuropeptide)
- When target species come into contact, their pheromone glands will be stimulated and thus attract more of their own kind into the capturing device.

### [2015 iGEM Consort, Alberta](#) **(High School)**

- Alberta, the economy is based almost entirely on agriculture and the oil industry. These two portions of the economy coexist side by side
- oil wells are drilled on land adjacent to crops and cattle.
- Not currently a test that can check for oil contamination on the actual site, and there is little one can do after sending a sample to a city lab, which can sometimes take weeks for the results to come back.
- Environmental Contaminate Sensor, ECOS, is a biological sensor designed to detect aromatic hydrocarbons found in soil, particularly xylene, which corresponds to other carcinogenic compounds like benzene and toluene.

### [iGEM 2015 CCA San Diego](#) **( High School)**

- Using computer modeling, CCA San Diego simulated the behavior of a glucose sensing biosensor, which fluoresces in the presence of glucose.
- Monitor of blood glucose levels, a critical biomarker for diabetes.

## Backup topics

- I suggest we have 1 to 2 backup projects per iGEMers in case the students couldn't come up with one
- Could everyone that attends think of some please

## Judging form

Team:					
	1	2	3	4	5
Novelty					
Justifying the importance of project					
The use of science					
Poster					
Presentation					
Q&A skills					
Total:					
Comments:					